



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
-----------------	-------------	----------------------	---------------------	------------------

10/617,767

07/14/2003

Jung-Hyun Lee

249/349

4046

7590

09/02/2004

LEE & STERBA, P.C.
Suite 2000
1101 Wilson Boulevard
Arlington, VA 22209

EXAMINER

NOVACEK, CHRISTY L

ART UNIT

PAPER NUMBER

2822

DATE MAILED: 09/02/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/617,767	LEE ET AL.	
	Examiner	Art Unit	
	Christy L. Novacek	2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
 - If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
 - If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
 - Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 June 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-6,13-15,19 and 20 is/are rejected.
- 7) ☒ Claim(s) 7-12 and 16-18 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

This office action is in response to the amendment filed June 18, 2004.

Response to Amendment

The amendment of claim 2 is sufficient to overcome the rejection of claims 2, 4 and 7 under 35 U.S.C. 112, second paragraph. Therefore, this rejection is withdrawn.

The rejection of claims 3 and 10 under 35 U.S.C. 112, second paragraph are also withdrawn.

The amendment of claim 5 is sufficient to overcome the rejection of claim 5 under 35 U.S.C. 112, second paragraph. Therefore, this rejection is withdrawn.

The limitations added to claims 7-12 are sufficient to overcome the Ma, Yoon and Kirilin references, either alone or in combination. Therefore, the rejections of claims 7-12 are hereby withdrawn.

Claim Rejections - 35 USC § 102

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 1-6, 13-15, 19 and 20 are rejected under 35 U.S.C. 102(a,e) as being anticipated by US 6,407,435 ("Ma", previously cited).

Regarding claim 1, Ma discloses a method of making a dielectric stack by sequentially depositing a plurality of barrier layers (preferably Al_2O_3) and a plurality of high-k layers (preferably ZrO_2 , but also BST) over a substrate to form a multilayer stack (col. 4, 11. 26-45; steps 520, 530, Fig. 9) followed by annealing the stack (step 550, Fig. 9) and depositing an

Art Unit: 2822

electrode (step 560, Fig. 9). Ma does not specifically state that the annealing step serves to diffuse material in the barrier layers into adjacent dielectric layers. However, the annealing step is conducted at a temperature of 400-900°C within the same range of temperatures disclosed by Applicant, Ma recites using the same materials as those disclosed by Applicants, and Ma recites that the annealing is carried out “to condition the high-k layers and the interposing [barrier] layers as well as the interfaces between the various layers” (col. 7, ln. 23-27). Therefore, it appears that the annealing step of Ma would inherently possess the function of causing diffusion of material in the oxidation barrier layer into the adjacent dielectric layers sufficient to alter at least one characteristic of each of the plurality of dielectric layers. See *In re Swinehart*, 439 F.2d 210, 212-13, 169 USPQ 226, 229 (CCPA 1971) “where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that the subject matter shown to be in the prior art does not possess the characteristics relied on ”); and *In re Fitzgerald*, 619 F.2d 67, 205 USPQ 594 (CCPA 1980) (a case indicating that the burden of proof can be shifted to the applicant to show that the subject matter of the prior art does not possess the characteristic relied on whether the rejection is based on inherency under 35 U.S.C. 102 or obviousness under 35 U.S.C. 103).

Regarding claims 2-4, Ma discloses that the barrier layers can be made of Al₂O₃.

Regarding claim 5, Ma discloses that the barrier layers are “less than 50Å thick” (col. 4, ln. 26-46).

Regarding claim 6, Ma discloses that the thickness of the barrier layer is adjustable (col. 5, ln. 62-67).

Regarding claims 13 and 14, Ma discloses using both CVD and ALD to deposit the barrier layer (col. 6, 11. 36-39). ALD or "pulsed CVD" is a specific instance of CVD.

Regarding claim 15, BST can be used as the dielectric.

Regarding claims 19 and 20, as stated above in reference to claim 1, it appears that the annealing step of Ma will inherently function to diffuse material in the barrier layers into adjacent dielectric layers. Such diffusion at the high temperature at which the annealing step is conducted, will inherently cause some chemical bonds in the dielectric layers to break and new bonds to form. This process inherently changes the lattice constant in the dielectric layers by some amount.

Claims 1-6, 13, 14, 19 and 20 are rejected under 35 U.S.C. 102(b) as being anticipated by US 5,688,724 ("Yoon", previously cited).

Regarding claims 1-4, Yoon teaches a method of making a dielectric structure comprising the steps of depositing a first dielectric layer (32) on a substrate (30, Fig. 14), depositing a second dielectric layer (34) on the first dielectric layer (32), depositing a third dielectric layer (36) on the second dielectric layer (34) depositing a fourth dielectric layer (38) on the third dielectric layer (36), depositing a fifth dielectric layer (40) on the fourth dielectric layer (38) to form a dielectric stack (90). The first, third, and fifth dielectric layers (32, 36, and 40) are secondary dielectric layers (silicon oxide, silicon nitride, titanium dioxide, or aluminum oxide). The second and fourth dielectrics are primary dielectric layers (tantalum pentoxide, aluminum oxide, titanium dioxide). Annealing is performed after depositing the dielectric layers (col. 8, 11. 43-44). Assuming the secondary dielectric layers to correspond to Applicant's "oxidation barrier", Yoon discloses diffusing material (oxygen) in each of the oxidation barrier layers into

Art Unit: 2822

adjacent primary dielectric layers sufficient to alter at least one characteristic (crystallinity) of each of the plurality of primary dielectric layers.

Regarding claim 5, Yoon discloses that the secondary dielectric layers have a thickness of 10-50Å (claim 4).

Regarding claim 6, Yoon discloses that the thickness of the secondary dielectric layers is adjustable (col. 9, ln. 44-62).

Regarding claims 13 and 14, Yoon discloses that the secondary dielectric layers can be formed by CVD.

Regarding claims 19 and 20, Yoon discloses that the annealing step converts the structure of the primary dielectric layers from having an amorphous crystal structure to having a polycrystalline structure. Inherently, this will alter the lattice constant of the layers.

Response to Arguments

Applicant's arguments filed June 18, 2004 have been fully considered.

Regarding the rejection of claim 1 as being anticipated by Ma, Applicant states, "Claim 1 has been amended to clearly recite the purposefulness of this diffusion and define the present invention over incidental diffusion." The Examiner disagrees with this statement. There is no language in amended claim 1 that distinguishes it over incidental diffusion. Even incidental diffusion serves to "alter at least one characteristic" of the dielectric layers. Namely, incidental diffusion changes the chemical composition of the layers (however small that change may be). Additionally, Ma goes beyond disclosing incidental diffusion by stating that the anneal actually serves "to condition the high-k layers and the interposing [barrier] layers as well as the interfaces

Art Unit: 2822

between the various layers". As such, the rejection of claim 1 as being anticipated by Ma is maintained.

Regarding the rejection of claim 1 as being anticipated by Yoon, Applicant makes the same argument against that rejection as is mentioned above in reference to the Ma rejection of claim 1. Yoon goes beyond disclosing incidental diffusion by stating that oxygen diffuses into the primary dielectric layers through the second dielectric layers so as to change the crystallinity of the primary dielectric layers. As such, the rejection of claim 1 as being anticipated by Yoon is maintained.

Allowable Subject Matter

Claims 7-12 and 16-18 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37

Art Unit: 2822


CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christy L. Novacek whose telephone number is (571) 272-1839. The examiner can normally be reached on Monday-Thursday and alternate Fridays 7:30 - 5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (571) 272-1852. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

CLN
August 30, 2004


AMIR ZARABIAN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800